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Meteorology — Weather radar —

Part 1: System performance and operation

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Partie 1: Performance et fonctionnement des systèmes

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 146, *Air quality*, Subcommittee SC 5, *Meteorology*, and by the World Meteorological Organization (WMO) as a common ISO/WMO Standard under the Agreement on Working Arrangements signed between the WMO and ISO in 2008.

A list of all parts in the ISO 19926 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The rapid development of weather radar occurred just before and during the Second World War. Initially, radar was demonstrated at long (10 m to 50 m) wavelengths, but quickly moved to shorter wavelengths (3 cm and 10 cm) with the requirement for, and development of, compact and high-power transmitters. C-band (5 cm) wavelengths were available in the late 1950s. The first operational Doppler radars appeared in the mid-1980s, with demonstration of the technology's application in operations and the availability of high-speed, affordable processors and efficient software codes. The adoption of dual-polarization capability for operational radars followed in the mid to late 1990s.

Radars provide localized, highly detailed, timely and three-dimensional sensing and observing capability that no other meteorological monitoring system can provide. They are able to measure variations in precipitation rates at a resolution of a few square kilometres or better and at time cycles of the order of a few minutes. They provide the capability to monitor rapidly evolving weather events, which is critical for the provision of early warnings of severe and hazardous weather. This includes heavy rain, hail, strong winds (e.g. tornadoes and tropical cyclones) and wind shear; the conditions that have the highest impact on society of all the weather elements. Doppler and dual-polarization radars are able to resolve the high variability of wind and precipitation types, and even see insects or clear air turbulence used to predict the onset of thunderstorms and for measuring vertical wind profiles. Dual polarization is also used for quality assurance and to improve precipitation estimates.

With high speed telecommunications and data processing, radar systems are now networked to better monitor large-scale weather phenomena, such as tropical cyclones and major extra-tropical storms (both in summer and winter). The data derived from the networking of radars can provide longer lead times (from 60 min to 90 min to several hours) for early warnings. Numerical weather prediction systems have also now advanced and the assimilation of continental-scale radar-derived precipitation data into global models can significantly improve the 4-day to 5-day precipitation forecasts of neighbouring areas and continents.

The provision of homogeneous, high-quality data starts with the installation and use of appropriate radar technology for the local weather environment and conditions. The wavelength of the radar, the beam width of the antenna, the type and power of the transmitter, the sensitivity of the receiver and the waveform all have significant impacts on the resolution and quality of radar data. Weather radars have traditionally been specified and configured to meet local requirements for weather monitoring and surveillance and to cater for local geography and other factors, leading to globally diversity in technology and in sampling strategies. These all impact on different data quality metrics, such as availability, timeliness and accuracy. These metrics also rely on the operation and maintenance of the radar systems through adherence to prescribed and standardized procedures and practices. This requires the establishment of standards, technical specification best practices and guidelines for network design, site selection, calibration, system and equipment maintenance, sampling and data processing, and distribution.

The purpose of this document is wide and addresses organizations in all countries using weather radar, with particular emphasis on countries that do not have a long tradition of weather radar operation and usage. It provides:

— support to manufacturers to maintain a comparable and high level of competitive weather radar systems;

— aid for tendering authorities to take into account state of the art of system performance as well as merely component definitions in their documents and, thus, to help to compare different incoming bids;

— provision of a valid documentation on the potential and limitations of weather radar systems, thus supporting capacity building worldwide;

— advice on the general requirements for siting, operation, maintenance and calibration tasks to keep radar systems on a high level of data quality and availability;

— a description of the required range of tasks for operating and maintaining weather radar systems in order to let managers allocate enough financial resources and staff capacity for this purpose.

Further information, such as the fundamentals of weather radar measurement, can be found in Reference [1].

Meteorology — Weather radar —

Part 1: System performance and operation

1 Scope

This document specifies system performance of ground-based weather radar systems measuring the atmosphere using frequencies between 2 GHz and 10 GHz. These systems are suitable for the area-wide detection of precipitation and other meteorological targets at different altitudes. This document also describes ways to verify the different aspects of system performance, including infrastructure.

This document is applicable to linear polarization parabolic radar systems, dual-polarization and single-polarization radars. It does not apply to fan-beam radars [narrow in azimuth (AZ) and broad in elevation (EL)], including marine and aeronautical surveillance radars, which are used for, but are not primarily designed for, weather applications. Phased-array radars with electronically formed and steered beams, including multi-beam, with non-circular off-bore sight patterns, are new and insufficient performance information is available.

This document does not describe weather radar technology and its applications. Weather radar systems can be used for applications such as quantitative precipitation estimation (QPE), the classification of hydrometeors (e.g. hail), the estimation of wind speeds and the detection and surveillance of severe meteorological phenomena (e.g. microburst, tornado). Some of these applications have particular requirements for the positioning of the radar system or need specific measurement strategies. However, the procedures for calibration and maintenance described in this document apply here as well.

This document addresses manufacturers and radar operators.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

4 Abbreviated terms

ADC	analogue–digital converter
AZ	azimuth
BITE	built-in test equipment
BPF	band-pass filter